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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
E01F 9/012

A1

(11) International Publication Number: WO 99/24671

(43) International Publication Date: 20 May 1999 (20.05.99)

(21) International Application Number: PCT/US98/05929

(22) International Filing Date: 24 March 1998 (24.03.98)

(30) Priority Data:
08/968,199 12 November 1997 (12.11.97) US

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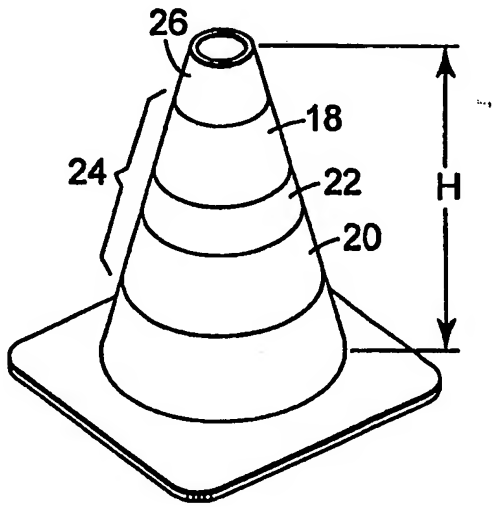
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

**Published**
*With international search report.*

(54) Title: MULTICOLORED RETROREFLECTIVE BANDED SLEEVE FOR A TRAFFIC DEVICE AND METHOD OF MAKING

(57) Abstract

A multicolored sleeve (24) is formed as a piece of retroreflective sheeting having an upper (18) and a lower band (20) of one color. A central area (22) of a second color, either a transparent ink, a transparent film, or a retroreflective film, is applied to the surface of the retroreflective sheeting to form precisely spaced bands of color. The retroreflective sheeting can be formed into a sleeve and the sleeve then applied and bonded in a single step onto a conical–shaped or cylindrical–shaped traffic device.



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# MULTICOLORED RETROREFLECTIVE BANDED SLEEVE FOR A TRAFFIC DEVICE AND METHOD OF MAKING

## TECHNICAL FIELD

This invention relates to a retroreflective sleeve having spaced bands of the same color separated by a central area of a different color.

## BACKGROUND OF THE INVENTION

Traffic devices are used to channel traffic, divide opposing traffic lanes, divide traffic lanes when two or more lanes are kept open in the same direction, and delineate the boundaries of temporary maintenance and utility work zones. The term "traffic device" includes, but is not limited to, bodies such as cones that are integrally formed from a flexible polymeric material that can be struck by a moving vehicle without significantly damaging the vehicle on impact, and having a base portion for supporting an upright, generally conical or cylindrical member. Examples of traffic devices include cones, drums, tubes, stakes, and posts.

A common method of enhancing the visibility of such a traffic device is to place two spaced retroreflective bands onto its outer surface. The usual method of applying those bands is to coat an adhesive layer on the upper portion of the device, place a retroreflective band on the adhesive layer, coat a second adhesive layer on the lower portion of the cone, and place a second retroreflective band on the second adhesive layer. This is a four step, manual operation that is both time-consuming and imprecise.

The imprecision inherent in the method described above is undesirable, because government regulations often require that the retroreflective bands be of a certain size, and that they be placed at specified locations on the traffic device. For example, one standard for the use of retroreflective bands on traffic devices is "Standards and Guides for Traffic Controls for Street and Highway Construction, Maintenance, Utility, and Incident Management Operations" from the Manual on

Uniform Traffic Control Devices ("MUTCD") Part VI at page 65 (September, 1993) published by the Federal Highway Administration, United States Department of Transportation. According to the MUTCD standard, a traffic device measuring 71 centimeters (28 inches) high or more must have a white retroreflective upper band that is 15 centimeters (6 inches) wide, spaced no more than 7.6 to 10.2 centimeters (3 to 4 inches) down from the top of the device. The standard also requires a second white retroreflective band that has a width of 10.2 centimeters (4 inches), spaced at least 5.1 centimeters (2 inches) below the upper band. Preferably these bands must be located within a tolerance of ± 0.32 millimeters (± 0.25 inches).

The method described above for placing the spaced retroreflective bands on a traffic device has also been automated. For example, U.S. Patent No. 5,047,107 (Keller et al.) entitled "Method and Apparatus for Applying A Reflective Sleeve To A Traffic Cone," which is commonly assigned to the assignee of the present invention, describes an automated method for applying a reflective band to a traffic cone. The band is placed on a platform and the traffic cone is positioned in contact with one edge of the band and rotated to wind the band onto the traffic cone. The winding procedure is repeated to add the second band. The automated procedure is also a four step operation, and thus is time-consuming and relatively expensive.

Lastly, because conventional traffic devices are not retroreflective, the bare area between the upper and lower bands is not retroreflective and remains the color of the underlying device – typically orange. Thus, the central area appears orange during the daytime, but black during the night. This is also undesirable because the appearance of the work zone in which the device is placed should be the same both during the day and at night.

In view of the disadvantages associated with conventional traffic devices, it would be desirable to provide a multicolored banded retroreflective traffic device with consistent coloring both day and night and precise spacing between the bands.

## SUMMARY OF THE INVENTION

A sheeting is disclosed for forming a sleeve, comprising a retroreflective sheet having a retroreflective surface, the surface having a colored upper band and a colored lower band; and a central area on the retroreflective surface intermediate the upper and the lower bands, and having a color different from the color of the upper and the lower bands. In one embodiment, the upper and lower bands are white, and the color of the central area is selected from the group consisting of orange, fluorescent orange, fluorescent red-orange, and fluorescent yellow-orange. The central area may be formed by applying a film layer or colorant over the retroreflective sheeting in a desired area, and it provides the appearance when applied to a traffic device of two precisely spaced bands that have been separately applied.

## BRIEF DESCRIPTION OF THE DRAWINGS

The present invention is described in greater detail below in reference to the appended Figures, in which like structure is represented by like numbers in each of the several views, and wherein:

Figure 1 is a perspective view of sheeting showing upper and lower bands of a first color and a central area of a second color;

Figure 2 is a perspective view showing the sheeting of Figure 1 as a sleeve placed onto a conical-shaped traffic device;

Figure 3 is a perspective view of a rectangular piece of sheeting having upper and lower bands of a first color and a central area of a second color; and

Figure 4 is a perspective view showing the sheeting of Figure 3 as a sleeve placed on a cylindrical-shaped traffic device.

## DETAILED DESCRIPTION OF THE INVENTION

The present invention provides a single piece retroreflective sheeting appearing to have two precisely spaced bands, such that when the sleeve is placed in a single step onto a traffic device such as a cone, the portion of the device covered by the sheeting is fully retroreflective, has two bands (preferably white) that are precisely spaced apart, and has consistent colors both day and night.

Figure 1 shows retroreflective sheeting 5 having an upper edge 10 and a lower edge 12. Both edges 10 and 12 are arcuate so as to form a truncated cone-shaped sleeve that may be applied over the outer surface of a cone-shaped traffic device of the type shown in Figure 2. Side edges 14 and 16 connect the upper edge 10 to the lower edge 12. Side edges 14 and 16 form an included angle $\theta$ which for cones is generally about 30 degrees. An upper band 18 is adjacent the upper edge 10. A lower band 20 is adjacent the lower edge 12. A central area 22 divides the upper band 18 and the lower band 20. The dimensions of these bands 18 and 20 and the central area 22 may be selected as desired, and generally conform to standards for traffic devices, such as cones and cylindrical markers. One standard for these traffic devices is the MUTCD standard discussed above. For cylindrical-shaped traffic devices having a minimum height of 71 centimeters, the MUTCD standard requires that the upper and lower bands are white and have a width of about 8 centimeters. Under the standard, the central area is a band having a maximum width of about 16 centimeters and has a color selected from the group consisting of orange, fluorescent orange, fluorescent red-orange, and fluorescent yellow-orange.

The sheeting may either be formed into a sleeve before it is applied to a traffic or other device, or may just be applied to the device without having been pre-formed into a sleeve. The sheeting of Figure 1 may be wrapped to place the opposing side edges 14 and 16 in juxtaposition to form a sleeve 24. The sleeve has an inner side or adhering surface and a retroreflective surface or an outer viewing surface. In Figure 2, a sleeve is shown after placement on the outer surface 26 of a conical traffic device having a height H.

The sleeve of the present invention may also include additional bands above the upper band or below the lower band. For example, the top-most band could be orange, the upper band white, the center band orange, the central area orange, the lower band white, and the lower-most band orange. Other combinations are, of course, also possible.

Figure 3 shows a generally rectangular piece of retroreflective sheeting 29, which includes an upper edge 30 and a lower edge 32. Both the upper edge and the lower edge are straight and equal in length. An upper band 34 is adjacent to the upper edge 30. According to the MUTCD standard, the white upper band 34 has a width of 7.6 centimeters (3 inches) and is placed a maximum of 5.1 centimeters (2 inches) down from the top 40 of the generally cylindrical marker shown in Figure 4. The central area 36 is shown as a band having a maximum width of 15.2 centimeters (6 inches) . The central area 36 divides the upper band 34 from a lower band 38. The lower band 38 is white and has a width of 7.6 centimeters (3 inches). Other sizes may, of course, be selected.

The sheeting of Figure 3 may be wrapped to place the side edges 42 and 44 in juxtaposition to form a sleeve 48. In Figure 4, the sleeve 48 is shown placed on the outer surface 46 of a cylindric traffic device.

SELECTION OF RETROREFLECTIVE SHEETING

The two most common types of retroreflective sheeting suitable for use in the present invention are microsphere- based sheeting and cube corner-based sheeting.

Microsphere sheeting, sometimes referred to as "beaded sheeting," is well known to the art and includes a multitude of microspheres typically at least partially embedded in a binder layer, and associated specular or diffuse reflecting materials (such as metallic vapor or sputter coatings, metal flakes, or pigment particles). There are also "slurry coated" and lens-based sheetings in which the beads are in spaced relationship to the reflector but in full contact with resin. There are also "exposed lens," retroreflective sheetings in which the reflector is in direct contact with the bead but the opposite side of the bead is in a gas interface. Illustrative examples of microsphere-based sheeting are disclosed in U.S. Patent Nos. 4,025,159 (McGrath); 4,983,436 (Bailey); 5,064,272 (Bailey); 5,066,098 (Kult); 5,069,964 (Tolliver); and 5,262,225 (Wilson).

Cube corner sheeting, sometimes referred to as prismatic, microprismatic, or triple mirror reflector sheetings, typically includes a multitude of cube corner elements to retroreflect incident light. Cube corner retroreflectors typically comprise a sheet having a generally planar front surface and an array of cube corner elements protruding from the back surface. Cube corner reflecting elements comprise generally trihedral structures which have three approximately mutually perpendicular lateral faces meeting in a single corner -- a cube corner. In use, the retroreflector is arranged with the front surface disposed generally toward the anticipated location of intended observers and the light source. Light incident on the front surface enters the sheet and passes through the body of the sheet to be totally internally reflected by the faces of the elements, so as to exit the front surface in a direction substantially toward the light source. The light rays are typically reflected at the lateral faces due to total internal reflection, or by reflective coatings, as previously described, on the back side of the lateral faces. Illustrative examples of cube corner-based retroreflective sheeting are disclosed in U.S. Nos. 5,138,488 (Szczech ); 5,387,458 (Pavelka ); 5,450,235 (Smith); 5,605,761 (Burns); and 5,614,286 (Bacon).

Regardless of the type of retroreflective sheeting, such sheeting has a retroreflective surface which is the exposed outer viewing surface. The opposing surface is typically the adhering surface which is usually positioned against the outer surface of the traffic device.

It may be easier to wrap retroreflective sheeting around the exposed or outside surface of either a cone-shaped or a cylindrical-shaped traffic device when the sheeting is "flexible," "conformable," or "embossable," and thus those types of sheetings may be preferred for use with the present invention. Illustrative examples of such sheeting are disclosed in the prior mentioned U.S. Patent Nos. 5,138,488 (Szczech ); 5,387,458 (Pavelka ); 5,450,235 (Smith); 5,605,761 (Burns); and 5,614,286 (Bacon). However, any retroreflective sheeting has been found to be useful for the present application. In this application, white retroreflective sheeting is particularly useful, and "white" generally means conformance to the color for white specified in the heretofore

referenced MUTCD standard. Preferably any retroreflective sheeting selected shall have a retroreflectivity under wet or rainy conditions not less than 70% of its retroreflectivity under dry conditions. Further description of retroreflection and retroreflective sheeting is found in "Standard Specification for Retroreflective Sheeting for Traffic Control" ASTM D 4956-94 (November, 1994).

FORMING THE RETROREFLECTIVE SHEETING

Forming of retroreflective sheeting is described in Information Folder 1.1 "Cutting, Matching, Premasking, and Prespacing of Scotchlite™ Reflective Sheetings and Films" ( April, 1992 ) available from Minnesota Mining and Manufacturing Company (3M) of St. Paul, Minnesota. For example, single sheets can be hand cut, die cut, or cut electronically using a computer controlled machine. Volume cutting can be accomplished by methods such as band sawing, roll cutting, or guillotining. Such methods can be used for forming the retroreflective sheeting into pieces having the desired shape for forming sleeves.

FORMING THE CENTRAL AREA

The central area is typically the same color as the underlying device, so that the device appears to have two individual spaced bands. The central area having a second color can be provided either before or after the sheeting is shaped. The central area can be provided on the retroreflective surface of the sheeting by a variety of techniques, such as painting, spraying, or printing a imaging medium (such as ink, dye, pigment, or toner powder), and laminating another layer over the retroreflective sheeting. One method is to screen print a colored ink onto the retroreflective or viewing side of the sheeting. There are many known commercially available inks known to the art. A typically one is a vinyl alkyd base ink containing a pigment or dye, such as the transparent orange ink available from 3M under the designation SCOTCHLITE™ Process Color 906. Examples of commercially available organic orange pigments are PO 5, PO 15, PO 16, PO 31, PO34, PO36, PO 43, PO 48, PO 51, PO 60, and PO 61 all available from Heucotech, Fairless Hills, Pennsylvania. Other examples of manufacturers of pigments and dyes are CIBA-GEIGY Corporation, Pigments Division,

Oak Brook, Illinois; SUN CHEMICAL Corporation, Dispersions Division, Amelia, Ohio; and PENN COLOR Incorporated, Doylestown, Pennsylvania. Durable UV curable transparent inks are also available from 3M under the designation SCOTCHCAL™ U.V. Screen Printing Inks Series 9700.

Traffic cones are typically orange, but each manufacturer may make a slightly different shade of orange. Examples of cone manufacturers are A&B Reflection in Ontario California, Lakeside Plastics in Oshkosh, Wisconsin and Radiator Specialties in Charlotte, North Carolina. In one embodiment of this invention, the central area can be varied in shade and hue until the color of the central area nearly matches the color of the cone. This color matching improves the quality of the cone as perceived by the customer.

Another way to form the central area is to place a separate colored film across the retroreflective sheeting wherein the colored film has an adhesive on a bottom surface thereof for bonding to the retroreflective sheeting. The colored film may also be heat or vacuum bonded to the retroreflective sheeting. Such a colored film provides a similar effect as screen processing a colored ink onto the retroreflective sheeting. The film is preferable transparent but may be retroreflective. Examples of suitable colored transparent films are available as ELECTROCUT™ Film and SCOTCHCAL™ Non-Reflective Marking Films, available from 3M. The ELECTROCUT™ film is a transparent polymethylmethacrylate-based film which has a clear pressure sensitive adhesive and a paper liner backing on one side. 3M also sells a clear Protective Overlay Film that, if suitably colored, would serve as a colored film. These are vinyl films but other transparent polymeric films, such as acrylic, are also suitable. The film may also be colored retroreflective sheeting using the materials previously described.

The central area could also be formed on the retroreflective surface of the sleeve after placement of the sleeve on the outer surface of the traffic device. For example, a sleeve of retroreflective sheeting could be bonded to the outside surface of a

traffic device and then an orange colored retroreflective band applied to the surface of the sleeve in the proper position to form the central area.

FORMING A SLEEVE

If it is desired to form a sleeve prior to applying the sheeting to a device, the sheeting may be wrapped with the retroreflective side outward until the side edges are in juxtaposition. The side edges may be overlapped, be spliced so that the edges meet to form a butt joint, or placed so that the edges do not contact each other, but are in close proximity.

Alternately, fastening means may be used to hold the sleeve edges in juxtaposition. The sleeve may be adhesive coated or the device may be adhesive coated or both and the sleeve then placed onto the cone. Both mechanical and chemical fastening means may be used to hold the sleeve edges in a wrapped condition prior to placement onto the cone. Chemical means include as examples double stick tape, pressure-sensitive adhesives, and thermal adhesives. Mechanical means include as examples stitching, staples, rivets, screws, brackets, hooks, hook and loop, and nails.

BONDING THE SHEET OR SLEEVE ONTO THE TRAFFIC DEVICE

The preferred method of bonding the sleeve onto the traffic device is to adhere the sleeve onto the outer surface of the device. An adhesive is typically brushed on to form a coating on the outside surface of the traffic device. The coatings are typically brushed on at a thickness of about 60 micrometers. The use of adhesives on cone collars is described in U.S. Patent No. 5,026,204 (Kulp et al.), assigned to the assignee of the present invention. Adhesives may be readily selected by one skilled in the art. A substantial number of pressure-sensitive adhesives (PSAs) are known in the art which have good adhesion to the outer surfaces of traffic devices. These PSAs include, but are not limited to, rubber-based adhesives, non-polar acrylates, tackified acrylics, polybutadiene, cis-polyisoprene, epoxy resin, silicone resin, and polyalphaolefins.

Adhesives with superior outdoor durability are desirable because the articles of the present invention are subject to harsh weather and road conditions, such as temperature extremes, atmospheric pollutants, salt solutions, and infrared, visible, and ultraviolet light. Acrylic PSAs exhibit excellent outdoor durability, whereas rubber-based PSAs may show poor ultraviolet and oxidative stability owing to chemical unsaturation of the hydrocarbon elastomer. An adhesive layer may already be present on some commercial sheetings. However additional adhesive brushed on as described is usually preferred to achieve sufficient bonding to the outer surface of either a cone-shaped or cylinder-shaped device. A primer can also be applied on the surface of the device prior to placing the coated adhesive. Adhesives may be prepared using any suitable method. Adhesives may be crosslinked via chemical crosslinkers or actinic radiation, including electron beam or ultraviolet exposure. Tackifiers and plasticizers are commonly added to adhesives to improve wetting at the surface. For example, a compatible and a stable tackifier such as a rosin ester, a terpene phenolic resin, or a hydrocarbon resin may be incorporated. Plasticizers tend to improve bonding, but decrease peel strength.

The sleeve may also have its internal surface (adhesive side or non-retroreflective side) coated at least in part with adhesive for adherence to the traffic device.

This invention is further illustrated by the following Example.

## EXAMPLE

A cellular white encapsulated lens retroreflective sheeting white available from 3M under the designation SCOTCHLITE™ High Intensity Grade 3840 was cut into a single piece segment for making a cone sleeve. The sheeting had a retroreflective surface and an opposing surface. The upper edge and the lower edge were cut at a radius of 28 centimeters and 58 centimeters, respectively. Thus both the upper edge and the lower edge were arcuate. The opposing side edges formed an included angle $\theta$ equal to 30 degrees (as shown in Figure 1) and connect the upper edge to the lower edge.

The length of the side edges was 30 centimeters. A 5.1 centimeter wide central area of fluorescent transparent orange ink, available from 3M under the designation number 906, which is an vinyl alkyd base ink containing an orange dye, was screen printed on the outer side or retroreflective side of the sheeting between and generally parallel to the upper edge and the lower edge and connecting the opposing side edges. The resultant central area of fluorescent orange was parallel to the upper edge and the lower edge so as to divide the sheeting into a 15 centimeter wide upper white band and a 10.2 centimeter wide lower white band. A 2 centimeter wide strip of SCOTCH™ VHB double stick tape, available from 3M, was adhered to the retroreflective surface parallel to one side edge. The opposing side edge was then wrapped over and bonded to the double stick tape to form a sleeve. The inner surface of the sleeve corresponded to the adhesive side or inner surface of the sheeting.

The outside surface of a conical traffic device was coated with a pressure sensitive adhesive in a band extending between 9 centimeters and 39 centimeters down from the top of the device. The sleeve was then placed onto the adhesive coated area. The result was a sleeve on a device that formed a fully retroreflective traffic device, conforming to the MUTCD Standard.

The various modifications and alterations of this invention will be apparent to those skilled in the art without departing from the scope and spirit of this invention and this invention should not be restricted to that set forth herein for illustrative purposes only. For example, the sleeve of the invention could be used as flat sheeting on a sign face, on a triangular sign shaped to resemble a cone or other traffic device.

I claim:

1. A sheeting for forming a sleeve, comprising:

(a) a retroreflective sheet having a retroreflective surface, the surface having a colored upper band and a colored lower band; and

(b) a central area on the retroreflective surface intermediate the upper and the lower bands, and having a color different from the color of the upper and the lower bands.

2. The sheeting of claim 1, wherein the upper and lower bands are white, and the color of the central area is selected from the group consisting of orange, fluorescent orange, fluorescent red-orange, and fluorescent yellow-orange.

3. The sheeting of claim 2, wherein upper and lower edges of the sheet are arcuate and the sheet may be formed into a sleeve that may be applied on the outside surface of a conical-shaped traffic device.

4. The sheeting of claim 1, wherein the central area forms a continuous central band.

5. The sheeting of claim 1, wherein the central band comprises a colored film applied to the retroreflective surface.

6. The sheeting of claim 1, wherein the central band comprises an imaging medium applied over the sheeting.

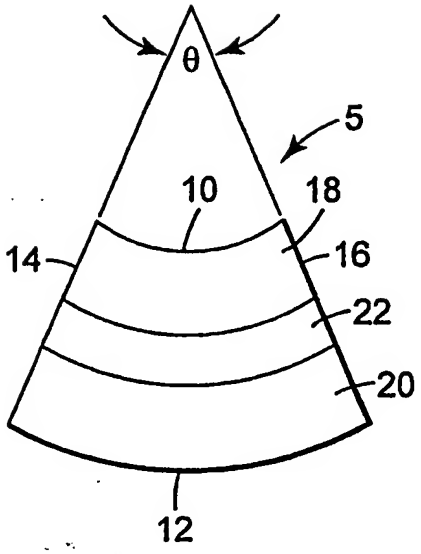


Fig. 1

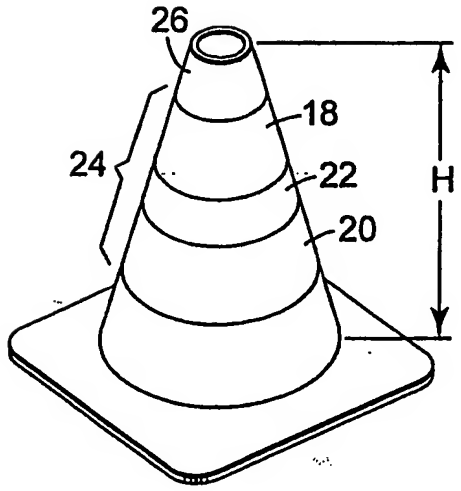


Fig. 2

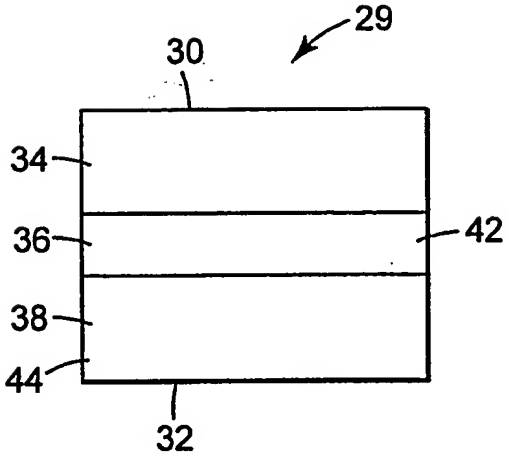


Fig. 3

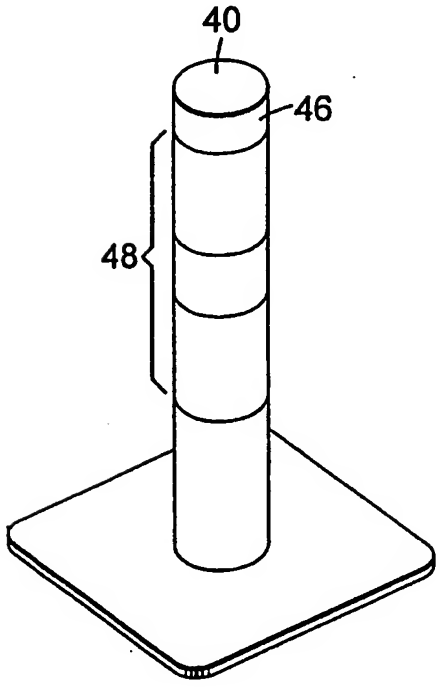


Fig. 4

# INTERNATIONAL SEARCH REPORT

Ir tional Application No
PCT/US 98/05929

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 E01F9/012

According to International Patent Classification(IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 E01F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X | GB 1 078 785 A (A.D. CROMPTON LIMITED) 9 August 1967<br>see page 1, line 42 - page 2, column 3; figures | 1,3 |
| A | EP 0 607 001 A (SWINTEX) 20 July 1994<br>see page 2 - page 5, line 33; figure 1 | 1 |
| A | GB 1 105 417 A (SWINTEX LIMITED) 6 March 1968<br>see page 1, line 40 - page 2, column 63; figures | 1,3 |
| A | GB 2 139 116 A (MINNESOTA MINING & MFG) 7 November 1984<br>see page 1, line 57 - page 2, column 13; figures | 1,3 |

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[X] Further documents are listed in the continuation of box C.

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| Name and mailing address of the ISA | Authorized officer |
|---|---|
| European Patent Office, P.B. 5818 Patentlaan 2<br>NL - 2280 HV Rijswijk<br>Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,<br>Fax: (+31-70) 340-3016 | Paetzel, H-J |

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